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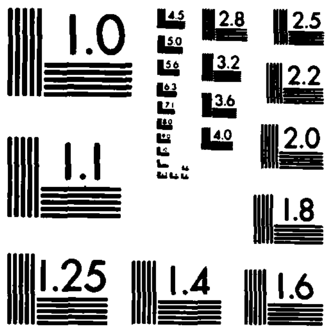

US Army Corps
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Construction Engineering
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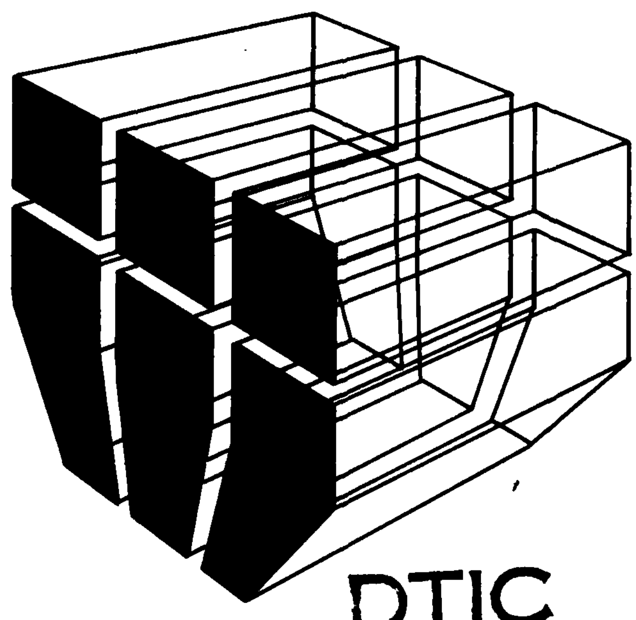
AD-A158 600

Training Impact Prediction System Users Manual

by
Robert E. Riggins
John C. Kaden



This report describes the use and implementation of the Training Impact Prediction System (TIPS)—an interactive, user-friendly, computer-based system Army planners and land managers can use to predict environmental impacts on Army training lands. TIPS is an integral part of land management technology being developed to help maintain Army training areas. Input and output data requirements are discussed in terms of using either a mainframe terminal or a personal computer. TIPS is described in terms of system structure, potential system uses, prediction techniques, and database management procedures. The system is accessed through the Environmental Technical Information System.

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This report describes the use and implementation of the Training Impact Prediction System (TIPS)--an interactive, user-friendly, computer-based system Army planners and land managers can use to predict environmental impacts on Army training lands. TIPS is an integral part of land management technology being developed to help maintain Army training areas. Input and output data requirements are discussed in terms of using either a mainframe terminal or a personal computer. TIPS is described in terms of system

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structure, potential system uses, prediction techniques, and database management procedures. The system is accessed through the Environmental Technical Information System.

FOREWORD

This study was performed for the Office of the Assistant Chief of Engineers (OACE) under Project 4A762720A896, "Environmental Quality of Military Facilities"; Technical Area \, "Installation Environmental Management Strategy"; Work Unit 026, "Training Area Impact Prediction." The work was performed by the Environmental Division (EN), U.S. Army Construction Engineering Research Laboratory (USA-CERL). Mr. Donald Bandel, DAEN-ZCF-B, was the OACE Technical Monitor.

Dr. R. K. Jain is Chief of USA-CERL-EN. COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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1 INTRODUCTION

Background

Army installations must maintain the utility of training lands, while at the same time protecting the environment. Maintenance of Army training lands is important because the acquisition of new lands is difficult and because current training practices use the lands more intensively than in the past.

The effects of training on land vary greatly and can lead to physical, chemical, and biological degradation. Physical degradation typically changes land morphology and results in changes in runoff from rainfall and the related processes of soil erosion and sediment transport. Another problem is loss of topsoil, which affects soil productivity and vegetative cover and can lead to gully formation.

The introduction of new weapons and new training methods has increased the environmental impact of Army training. Although more tracked vehicles, larger weapons, and greater land areas are now needed, the land available is limited, and no new land acquisitions are expected. As a result, the environmental impact of training continues to worsen, and there is growing concern that Army training lands will be degraded to a state that is no longer acceptable for training.

Army land managers want to maintain training land in a condition that will continue to support training; however, to do this, they need information systems and analysis tools.

The Training Impact Prediction System (TIPS) is an interactive, user-friendly, computer-based system that Army planners and land managers can use to predict environmental impacts on training lands. The land evaluation component of TIPS currently contains predictive techniques for erosion. Other system components continue to be developed. TIPS was developed by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) as part of the Environmental Technical Information System (ETIS).[1]

The system is an integral part of land management technology being developed to help maintain these training lands. Primary uses of the prediction system will be to evaluate the current condition of the land and to predict future land condition based on proposed training or land maintenance activities. Output from the system should provide an excellent basis for discussing land management problems and priorities with command-level decision-makers. The system can also be used for environmental impact analysis. The prediction system currently contains two types of physical process analysis tools: (1) the Universal Soil Loss Equation (USLE) and its various modifications and (2)

[1] R. Webster, R. L. Welsh, and R. K. Jain, *Development of the Environmental Technical Information System*, Interim Report E-52/ADA0096681 (U.S. Army Construction Engineering Research Laboratory [USA-CERL], 1975).

the Colorado State University (CSU) water and sediment yield model called MULTSED. TIPS also provides associated databases and links to other information systems.

The U.S. Department of Agriculture developed the USLE to predict average annual soil loss from field-sized areas. Subsequent modifications allow the equation to be used for time intervals other than average annual.

The CSU model routes water and sediment across the watershed and through the channel system. It is a complex physical process model which can be used for detailed study of sediment movement in training areas. By separating the processes of sediment supply and sediment transport, the model is a very effective tool for evaluating the effects of training or land maintenance activities on the condition of training areas.

A previous study provided the basis for the development of TIPS and selection of the prediction techniques.[2] Use of TIPS requires a substantial amount of input data which the user must collect. Detailed guidance for data acquisition will be developed in the next phase of this study.

Objective

The objective of this phase of the research is to develop a user manual for TIPS which describes the system structure, potential uses of the system, prediction techniques contained in the system, and database management procedures, and explains how to access TIPS via ETIS.

Approach

The system's capabilities and potential uses were outlined (Chapter 2) and the steps for accessing the system, selecting appropriate analysis techniques and entering/modifying input data described (Chapters 3 and 4).

Planned Additions to This Report

This report has been issued in looseleaf format, suitable for placement in a three-ring binder, in order to accommodate additional chapters. A chapter on data acquisition will be published in FY86, and information on additional systems components will be distributed as it becomes available.

Mode of Technology Transfer

TIPS will be implemented and made available to users through the ETIS. Army guidance for training area impact prediction will be included in a technical manual planned as part of USA-CERL's training area management research.

[2] R. E. Riggins and L. J. Schmitt, *Development of Prediction Techniques for Soil Loss and Sediment Transport at Army Training Areas*, Interim Report N-181/ADA144110 (USA-CERL, 1984).

2 SYSTEM CAPABILITIES AND USE

System Capabilities

TIPS combines models with a database management system that allows Army land managers to perform various analysis functions relating to the current and future condition of training lands. The models currently in the system are the USLE, the Interval ISLE, and the CSU model for water and sediment yield.

Many environmental biological mathematical models and database management systems have been produced over the past two decades. Kickert[3] recently produced two lists: named environmental-ecological models that are computer-accessible on the commercial market in 1984 and named models for environmental-ecological interactions in the published scientific literature. There were 40 models on the first list and more than 300 models on the second. He also found that only 21.8 percent of modeling publications (305 of 1401) referred to named models. The average Army land manager would have difficulty selecting appropriate analysis tools from among those listed.

The land manager has specific information interests. Therefore, the first objective of system development was to determine which analysis tools from among the wide range of available models should be used to provide the information of interest. Another objective was to make the system dynamic to allow for the addition of analysis tools as new requirements are identified and new models become available.

Army land managers perform two primary functions: (1) they must keep training land available in usable condition to support the training mission and (2) they must *conserve and obtain beneficial use of natural resources* to the maximum extent possible. Substantial amounts of information are required to perform these functions effectively.

The erosion process varies in space and time, and available analysis tools represent this process differently. The USLE predicts average annual soil loss from field-sized areas, but in TIPS, it has been modified to predict soil loss for shorter time intervals. These predictive tools are relatively simple to use and provide information that is widely used for land evaluation.

There is also a need for a more complex analysis tool, and the CSU water and sediment yield model MULTSED meets this requirement. This model is a physical process model and can be used to predict the movement of runoff and sediment across watersheds and through stream systems. It is a single-event model; i.e., it contracts the time dimension to a single event and broadens the space dimension to cover larger, watershed-sized areas. With these three models, TIPS can provide analysis tools that will meet all the land evaluation requirements of Army land managers.

System Use

TIPS is task-oriented. It provides users with task options to perform specific types of analysis that will provide information of interest. The task menu lists analysis options that meet the user's specific information requirements. Several land evaluation tasks

[3]R. N. Kickert, "Names of Published Computer Models in the Environmental Biological Sciences," *Simulation* (July 1984).

have been identified and are described in the following sections. These tasks are presented in order of the phases in which users are expected to begin using the system.

Build Databases

The user's first task will be developing databases for use in running the various TIPS models. This will be done with a Management Information System (MIS). The primary database, called the Locational Database (LDB), will consist of data records containing the input information needed to run the models. The data may vary in precision, depending on the accuracy of the acquisition method. This database will also contain default data for when users cannot develop more precise data. The data records will be related to specific watersheds or areas of the installation (thus the title "locational").

Land Evaluation

This task develops information needed to evaluate the present condition of a selected portion of land. The user needs this information to determine not only the condition of a specific land area, but also how that portion of land compares with other land areas on the installation. By analyzing several land areas, the user can rank their relative condition as a basis for setting maintenance activity priorities and determining the installation's overall land condition. The information may also be useful for scheduling land use for training activities. For example, it may be desirable to schedule training to avoid heavily damaged areas or limit training in sensitive land areas.

The first use of TIPS will probably be to analyze the land's present condition. Initially, users will be developing databases for their installations. This will probably begin with areas of immediate interest and continue until the entire installation is covered. As data is developed for watersheds, users will want to perform analyses to establish present condition. The first objective of TIPS operation may be to rank the relative condition of land areas on the installation. This activity may occupy TIPS users for some time. Output from land evaluation will be stored in the Evaluation Database (EDB).

Strategic Analysis

Questions that might be of interest to users and might relate to the land's present condition include:

Given a certain condition, what will soil loss be over a given length of time?

Where are the most damaged areas on the installation?

Given the present condition of an area, what should be done in terms of land maintenance?

What are the trends in land condition? (This last question will require analysis of land condition over time. Trends may require several years to become known.)

In this task, users manipulate and evaluate the information developed as a result of modeling. Essentially, this represents translating model output into decision-making information. The MIS to perform this task will operate on information in the EDB, which will contain output from the Land Evaluation Task, and on information from the Predictive Mode described below.

Predictive Mode

As TIPS becomes routinely operational at an installation, and as data has been developed and preliminary analysis performed for most of the installation, the system will be used in more of a predictive mode. Output from predictive modeling can be used directly and will be stored in the predicted database for use by the Strategic Analysis Task. Some of the questions of interest are:

What will be the effect of a certain land maintenance program?

What will be the effect of continued training?

What will be the effect of a certain training activity?

What land area is best for conducting scheduled training?

What land rotational scheme will minimize the training impacts?

Users will be modifying existing data records to represent an expected future condition and then performing analysis to predict the effect of that land condition on water and sediment yield. In this predictive mode, users will be able to estimate the relative effects of different training programs or alternative land maintenance activities. TIPS should become a useful tool for planning land use, scheduling land maintenance, and selecting from various land maintenance investment strategies.

Accessing TIPS

Users can access TIPS via ETIS in two ways: by dial-up using a terminal or by dial-up from a personal computer (PC). The PC gives the user additional capabilities which are essential if analysis of installation lands is extensive. With a PC, the user can develop and maintain data files locally. Output returned from TIPS analysis can also be maintained most conveniently on a PC. A terminal may be sufficient for the occasional user.

Detailed instructions on ETIS access and use are given in USA-CERL Technical Report N-69 (revised) [4] and therefore will not be covered here. However, a guide for accessing TIPS via ETIS is given below. An excellent overview of ETIS is provided in *Introduction to ETIS and Its Subsystems.*[5]

The following example session with ETIS shows how TIPS and its options may be accessed by following a menu-oriented system. Land Evaluation, which is the only operational subprogram on the TIPS menu, contains the USLE, IUSLE, and MULTSED options. Typical responses to questions on the menu are either a number, a carriage return, or "bye". ETIS is activated by typing the command "etis". In the example session, user input is indicated by underlining.

---

[4] D. P. Robinson, et al., *Economic Impact Forecast System II: User's Manual*, Technical Report N-69 (revised) /ADA144950 (USA-CERL, 1984).

[5] *Introduction to ETIS and Its Subsystems* (ETIS Support Center, University of Illinois, May 1984).

Example Session

% etis

ETIS (Trademark applied for)
United States Army Corps of Engineers
Environmental Technical Information System

ETIS: What program? (CR* to see list):

1 or intro	for an introduction to the Environmental Technical Information System and people to call for help with problems about using the programs.
2 or eics	for the Environmental Impact Computer-aided System.
3 or celds	for the Computer-aided Environmental Legislative Data System.
4 or eifs	for the Economic Impact Forecast System.
5 or afeics	for the Air Force Environmental Impact Computer-aided System.
6 or iicep	for the Interagency/Intergovernmental Coordination for Environmental Planning (IICEP).
7 or soils	for the Soils Systems (3 programs).
8 or ceas	for the Comprehensive Economic Analysis System (5 programs).
9 or misc	for the ETIS/MISCELLANEOUS systems, experimental operational programs.
10 or help	for HELP on using any of the ETIS systems or UNIX.
11 or rubouts	to ignore extraneous phone noise.
12 or end or bye	to exit from ETIS.
!mail	to see your mail.

ETIS: What program? (CR to see list): 9

Welcome to the ETIS/MISC systems.

All ETIS systems and MISCELLANEOUS programs are accessible from this menu. Both operational and experimental programs are contained here.

The newest entries: 26 Jun 84 - Training Impact Prediction System (TIPS) replaces WATSYS. MISC entry number 10.

ETIS/MISC: What program? (CR to see list): 10

TIPS provides USLE and MULTSED models for erosion, sediment yield, and water yield analysis. MULTSED requires an extensive database which must be created by the user. Contact Riggins, CERL-EN, for information (via "mail riggins"). TIPS is experimental and will change frequently as new programs are added and existing programs are modified. (In the outline below, missing numbers in the sequence refer to options that will be developed in the future.)

---

*CR notation means that user should depress the carriage return key.

Which topic? (CR to see list):

1. Land Evaluation
2. Guilds (Future)
3. Nutrient (Future)
4. Chemical Transport (Future)
9. Quit.

Which topic? (Type CR to see list): 1

Which option? (CR to see list):

1. Average annual USLE
2. Interval USLE
3. MULTSED
9. Stop.

Which option? (CR to see list): 3

Do you want a briefing on the option selected? yes

Information Briefing: MULTSED computes water and sediment yield for small watersheds. A physical process model, MULTSED requires considerable data on watershed/channel geometry, vegetation, soils, and hydraulic coefficients. The model is preceded by an edit routine which guides the user through the development of an input data file.

Current limits on model dimensions limit watershed segmentation to a maximum of 35 subwatersheds, 70 planes, 35 connection units, and a combination of 35 channels and/or reservoirs. In addition, no channel or reservoir may have more than two planes, three subwatersheds, one connection unit, or a combination of three upstream channels and/or reservoirs flowing into it. The maximum duration of a storm is 190 time increments.

MULTSED can produce intermediate output for planes and subwatersheds which includes:

1. Total area of the unit (acres)
2. Total volume of rainfall (acre-ft)
3. Total interception rainfall (acre-ft)
4. Total discharge (acre-ft)
5. Total sediment yield (lb)
6. Sediment yield by size fractions (lb)
7. Final hydrograph (min vs. cfs).

MULTSED output printed on the interactive device involves only the results at the outlet of the watershed. The following items appear:

1. Total volume of runoff (acre-ft)
2. Sediment yield by sizes (lb)
3. Discharge hydrograph (min vs. cfs).

Results for all the channel and reservoir units are written to a file and can be listed or routed to a printer. This information includes:

1. ISED number of unit
2. Time interval (min)
3. Discharge (cfs)
4. Total sediment concentration (ppm by weight)
5. Sediment concentration for each size fraction (ppm by weight)
6. Sediment yield by sizes for each unit (lb)
7. Average degradation or aggradation in channel units (ft) or, in the case of a reservoir, volume of deposited sediment (acre-ft)
8. Water yield for each unit (acre-ft).

MULTSED Program Option? (CR to see list):

1. Edit subwatersheds and planes
2. Execute msed1 - subwatersheds and planes
3. Execute msed2 - reformat files
4. Execute msed3 - channels with channel edit
9. QUIT.

MULTSED Program Option? (CR to see list): 9

Goodby from MULTSED

Which option? (CR to see list): bye

Ending Land Evaluation

Which topic? (CR to see list): bye

Goodby from TIPS

ETIS/MISC: What program? (CR to see list): bye

ETIS: What program? (CR to see list): bye

Main Steps

Table 1 summarizes the main steps involved in using TIPS. The USLE options do not require development of a datafile. All input data must be entered interactively by the user. The steps listed in Table 1 that refer to datafile development or transfer are required only if MULTSED is to be used. The table also shows the differences between terminal and PC use.

MULTSED has built-in editors to modify datafiles (see Chapter 3). The terminal user can make datafile modifications within TIPS without leaving ETIS to edit in the home directory. The PC user can either make modifications locally and transfer the new datafile or use the built-in editor.

To use the USLE options, the user simply dials up ETIS and selects from the menus to get the analysis function of interest.

Table 1

Main Steps for Using TIPS

Terminal

1. Dial-up the ETIS computer system.
2. Enter edit mode in home directory and create a datafile.
3. Access ETIS.
4. Select from menus to get analysis option.
5. Perform analysis.
6. Evaluate output in home directory.

Personal Computer

1. Create datafile on PC using Rbase.
2. Dial-up the ETIS computer system.
3. Transfer datafile to the mainframe.
4. Access ETIS.
5. Select from menus to get analysis option.
6. Perform analysis.
7. Return output to PC.

3 DATA INPUT: USLE

USLE

The USLE is used to determine average annual soil loss for field-sized areas. The user can select the USLE option from the Land Evaluation menu. The USLE is:

$$A = RKLSCP \qquad \text{[Eq 1]}$$

where:

A is the computed soil loss per unit area, expressed in the units selected for K and for the period selected for R. In practice, these are usually selected so that they compute A in tons per acre per year, but other units can be selected.

R (the rainfall and runoff factor) is the number of rainfall erosion index units, plus a factor for runoff from snowmelt or applied water where such runoff is significant.

K (the soil erodibility factor) is the soil loss rate per erosion index (EI) unit for a specified soil as measured on a unit plot, which is defined as a 72.6-ft (21.8-m) length of uniform 9 percent slope that is continuously in clean-tilled fallow.

L (the slope-length factor) is the ratio of soil loss from the field slope length to that from a 72.6-ft (21.8-m) length under identical conditions.

S (the slope-steepness factor) is the ratio of soil loss from the field slope gradient to that from a 9 percent slope under otherwise identical conditions.

C (the cover and management factor) is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled, continuous fallow.

P (the support practice factor) is the ratio of soil loss with a support practice like contour disking to that with straight-row farming up and down the slope.

Use of the USLE is described completely in Agriculture Handbook Number 537 and Technical Publication SA-TP 11[5]. These references provide information on how to select the various factors used in the USLE (Tables 2 through 4 in this report contain some of these factors). In TIPS, the user is prompted to input each factor. Default data and tables of factor values are part of the system and can be selected by the user.

The USLE provides output of average annual soil loss, usually in units of tons/acre. Soil loss is the amount of soil lost from the entire area, and the relationship does not provide information on deposition or movement of eroded sediments through the channel system.

[5] W. H. Wischmeier and D. D. Smith, *Predicting Rainfall Erosion Losses--A Guide to Conservation Planning*, Agriculture Handbook No. 537 (U.S. Department of Agriculture [USDA], 1978); G. E. Dissmeyer and G. R. Foster, *A Guide for Predicting Sheet and Rill Erosion on Forest Land*, SA-TP 11 (USDA Forest Service Southeastern Area, 1980).

Table 2

Effect of Bare Soil, Fine Root Mat of Trees, and Soil Reconsolidation on Untilled Soils*

Percent Bare soil	Percent of bare soil with dense mat of fine roots in top 3 cm of soil										
	100	90	80	70	60	50	40	30	20	10	0
0	.0000										
1	.0004	.0004	.0005	.0006	.0007	.0008	.0010	.0012	.0014	.0016	.0018
2	.0008	.0888	.0010	.0014	.0017	.0017	.0020	.0023	.0027	.0031	.0036
5	.003	.003	.003	.001	.002	.003	.007	.008	.009	.011	.012
10	.005	.005	.006	.008	.009	.011	.013	.015	.017	.020	.023
20	.011	.012	.014	.017	.020	.024	.028	.033	.038	.044	.050
30	.017	.018	.020	.025	.029	.036	.042	.050	.059	.068	.077
40	.023	.024	.027	.034	.042	.049	.058	.068	.079	.092	.104
50	.030	.032	.038	.045	.054	.064	.074	.088	.103	.118	.135
60	.037	.038	.043	.055	.067	.079	.092	.109	.127	.147	.167
70	.047	.049	.054	.068	.083	.098	.117	.138	.161	.187	.212
80	.055	.058	.066	.081	.098	.118	.141	.164	.192	.221	.252
85	.066	.069	.078	.095	.115	.138	.165	.195	.228	.264	.300
90	.075	.080	.089	.111	.133	.157	.187	.222	.260	.301	.342
95	.086	.090	.102	.125	.155	.182	.217	.255	.298	.345	.392
100	.099	.104	.117	.144	.180	.207	.248	.293	.342	.396	.450

*Source: *A Guide for Predicting Sheet and Rill Erosion on Forest Land,* Technical Publication SA-TP 11 (USDA Forest Service Southeastern Area, 1980).

Table 3

Canopy Subfactor*

Canopy Height Meters (feet)	Percent of bare soil with canopy cover										
	0	10	20	30	40	50	60	70	80	90	100
0.5-(01.5)	1.00	.91	.83	.74	.66	.58	.49	.41	.32	.24	.16
1.0-(03.2)	1.00	.93	.86	.79	72	.65	.58	.51	.44	.37	.30
2.0-(06.5)	1.00	.95	.90	.85	.80	.75	.70	.65	.60	.55	.50
4.0-(13.0)	1.00	.97	.95	.92	.90	.87	.84	.82	.79	.76	.74
6.0-(19.5)	1.00	.98	.97	.96	.94	.93	.92	.90	.87	.87	.85
8.0-(26.0)	1.00	.99	.98	.97	.96	.95	.95	.94	.93	.93	.92
16.0-(52.0)	1.00	1.00	.99	.99	.98	.98	.98	.97	.97	.96	.96
20.0-(65.0)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

*Source: *A Guide for Predicting Sheet and Rill Erosion on Forest Land*, Technical Publication SA-TP 11 (USDA Forest Service Southeastern Area, 1980).

Table 4

Steppe Effect on Slope*

Percent Slope	Percent of total slope in steppes										
	0	10	20	30	40	50	60	70	80	90	100
5	1.00	.99	.99	.98	.97	.96	.95	.94	.94	.93	.92
6	1.00	.97	.94	.92	.89	.86	.84	.81	.78	.76	.73
7	1.00	.96	.92	.88	.84	.80	.75	.71	.67	.63	.59
8	1.00	.95	.90	.85	.80	.75	.69	.64	.59	.54	.49
9	1.00	.94	.89	.83	.77	.71	.65	.60	.54	.48	.42
10	1.00	.94	.87	.81	.75	.68	.62	.56	.49	.43	.36
12	1.00	.93	.85	.78	.71	.63	.56	.49	.42	.34	.27
15	1.00	.92	.84	.75	.67	.59	.51	.43	.34	.26	.18
20	1.00	.91	.82	.74	.65	.56	.47	.38	.29	.20	.11
30+	1.00	.91	.81	.72	.63	.53	.44	.35	.25	.15	.06

*Source: *A Guide for Predicting Sheet and Rill Erosion on Forest Land*, Technical Publication SA-TP 11 (USDA Forest Service Southeastern Area, 1980).

The USLE is an excellent tool for quickly assessing the land's overall condition. Although TIPS prompts the user for input of the factor values, the personal computer user may want to maintain a localized database of factor values for the various land areas on the installation. USLE can be used as a predictive tool. The erodibility factor and the cover factor are the input data elements that would be modified when the USLE is used in predictive mode. An example of a USLE session is provided below.

Example USLE Erosion Estimates

Two examples are given. The first is taken from SA-TP 11, p 5, Example 1. The second assumes an R-interval window of April-June and uses the same data for other factors as was used in the first example.

Example 1: Log in central Georgia on a 10 percent slope with a 120-ft (36-m) slope length on a soil having a K value of 0.24 ton/acre/EI unit. (This is an untilled situation.) Log exposed 15 percent bare soil, 30 percent of which has a 1.0-m-high canopy over it. All the bare soil has a fine root mat. The topsoil has a high organic content, 3 in. (76.2 mm) thick. Steppes occupy 10 percent of the slope. Depression storage was evaluated at 0.9.

Example 2: Logging operations will take place during the interval April-June for a period of 1 year. What will be the soil loss during this period for which erosion control practices must be designed? Assume an allowable 10 percent chance that erosion control will be underdesigned. All other land conditions are the same as given in Example 1.

Example 1: USLE Output

Which topic? (CR to see list):

1. Land Evaluation
2. Guilds
3. Nutrient
4. Chemical Transport
5. Biomodel
9. Quit

Which topic? (CR to see list): <u>1</u>

Which option? (CR to see list):

1. Average annual USLE
2. Interval USLE
3. MULTSED
9. Stop

Which option? (CR to see list): <u>1</u>

Do you want a briefing on the option selected? <u>yes</u>

Information Briefing: You will be prompted to input each factor directly. To obtain the factor value from a table, enter a carriage return. Files contain average annual R-

factors, and C and P tables. K-factors can be obtained from the ETIS/SIRS system. Enter installation code (CR to see list):

Aberdeen PG	01	Fort Drum	38
Carlisle Barracks	02	Fort Eustis	39
Dugway PG	03	Fort Gordon	40
Edgewood Arsenal	04	Fort Greely	41
Frankfort Arsenal	05	Fort Hamilton	42
Hunter-Liggett Mil. Res.	06	Fort Hancock	43
Jefferson PG	07	Fort Holabird	44
Joliet Army AP	08	Fort Hood	45
Natick Laboratories	09	Fort Huachuca	46
Oakland Army Base	10	Fort Irwin	47
Picatinny Arsenal	11	Fort Jackson	48
Pohakuloa Tng. Area	12	Fort Knox	49
Presidio of San Fran.	13	Fort Leonard Wood	50
Redstone Arsenal	14	Fort Leavenworth	51
Rock Island Arsenal	15	Fort Lee	52
Rocky Mountain Arsenal	16	Fort Lewis	53
Sandia Base	17	Fort MacArthur	54
Schofield Barracks	18	Fort McClellan	55
Sierra AD	19	Fort McCoy	56
US Military Academy	20	Fort McNair	57
Watervliet Arsenal	21	Fort Meade	58
Yakima Firing Center	22	Fort Monmouth	59
Yukon CMD Ing.	23	Fort Monroe	60
Yuma PG	24	Fort Myer	61
White Sands Missile Rng.	25	Fort Ord	62
Fort A.P. Hill	26	Fort Polk	63
Fort Belvoir	27	Fort Richardson	64
Fort Benjamin Harrison	28	Fort Riley	65
Fort Benning	29	Fort Ritchie	66
Fort Bliss	30	Fort Rucker	67
Fort Bragg	31	Fort Sam Houston	68
Fort Campbell	32	Fort Sheridan	69
Fort Carson	33	Fort Shafter	70
Fort Chaffee	34	Fort Sill	71
Fort Detrick	35	Fort Stewart	72
Fort Devons	36	Fort Wainwright	73
Fort Dix	37		

Enter installation code (CR to see list): 29

The R value is selected from the isoerodent map.

Enter R: 300

The K value is given.

Enter K: 0.24

Enter C factor (CR to see tables):

Which type of cover factor (CR to see list):

1. Pasture, Range and Idle Land.
2. Forest Land.

Which type of cover factor (CR to see list): 2

If tilled, enter 1; if untilled, enter 0: 0

In this case, bare soil was estimated during a field visit. Visual inspection was made to determine presence and extent of fine roots.

Enter bare soil/fine roots subfactor value selection: 0.008

Percent canopy cover and drop fall height were estimated during field inspection.

Enter canopy subfactor value selection: 0.79

The steppes subfactor is evaluated by estimating the percentage of the slope occupied by steppes and measuring the slope gradient.

Enter steppes subfactor value selection: 0.94

The observer evaluates onsite depression storage by estimating the proportion of the existing onsite erosion that will be trapped in these depressions. To get a depression storage value close to 0.0, the site must usually have a small amount of exposed soil and most erosion must occur adjacent to a depression that can trap and hold most eroded soil.

Enter depression storage subfactor value selection: 0.9

Topsoil with more than 4 percent organic matter and at least 1 in. (25.4 mm) thick will give a subfactor of 0.7. Otherwise, the value is 1.0.

Enter high organic content subfactor value selection: 0.7

C-factor for forest is 0.0037

Enter C-factor (CR to see tables): 0.004

P-factor is incorporated into the C-factor for forest soils, so P is set to 1.0.

Enter P-factor (CR to see tables): 1.0

The recommended method for determining slope is use of a clinometer. Slope length is paced, measured, or estimated in the field.

Enter LS

Enter slope length (ft): 120

How many equal length segments? 1

For each equal length segment

Enter gradient (decimal): .1

LS calculated to be 1.507

Ready to execute USLE with the following data:

R = 300.0
K = 0.240
LS = 1.507
C = 0.004
P = 1.000

Soil loss is 0.434 (wt/unit area).

Interval USLE

The user can also select the Interval USLE (IUSLE) option from the Land Evaluation menu. IUSLE differs from the USLE only in the R-factor. The USLE uses an average annual R-factor that has been predetermined. The IUSLE calculates an R-factor for the time interval of interest. The interval can range from a single storm to any other duration up to 1 year. This option also permits the introduction of risk as a factor in soil loss prediction. For example, the user can determine the soil loss associated with the 2-year rainfall or, as expressed another way, the soil loss associated with the rainfall that has a 50 percent chance of occurring in any given year.

The user can let the IUSLE R-factor represent the total interval erosivity or the erosivity of the maximum rainfall to be expected during the interval. IUSLE requires a precipitation datafile which must be developed for each installation. Users interested in IUSLE should contact USA-CERL for assistance in developing this datafile.

The user initiates the IUSLE option by specifying either the allowable risk of exceeding the design storm or the return interval of the design storm. This is used along with project duration (in years), to determine the design storm that satisfies the specified requirements. For example, consider a project which is to last 1 year or less. The duration will be 1 year. If the user wants only a 25 percent chance that the predicted soil loss value will actually be exceeded during the 1-year period, then that value should be entered in response to the prompt. These specifications (1-year duration and 25 percent risk of exceedance) will result in the calculation of the appropriate R-factor. A similar result would be obtained if the user were to specify a 4-year return interval instead of the 25 percent risk value.

IUSLE provides output similiar to the USLE except that the interval is not annual. IUSLE can also be used in a manner similar to USLE for predictions.

An example of an IUSLE session is provided below.

Example 2: Interval USLE Output

Which option? (CR to see list): 2

Do you want a briefing on the option selected? yes

Information Briefing: You will be prompted to input each factor directly. To obtain the factor value from a table, enter a carriage return. Files contain average annual R-factors, and C and P tables. K-factors can be obtained from the ETIS/SIRS system.

The R-factor for an interval or a single storm can be calculated for a given return interval or given risk of exceedance. You will be prompted first for a return interval. Entering a carriage return will result in a prompt for a risk of exceedance value. For example, entering 20 means that you are allowing a 20 percent chance that a storm greater than the one to be used in the prediction will actually occur.

Do you want a data brief? yes

Select any option or combination by entering the corresponding numbers in any order.

1. Rank interval and maximum storm R-factors for period of record
2. Determine interval R-factor using specified risk of exceedance
3. Determine maximum R-factor using specified risk of exceedance
4. Determine interval R-factor using specified return period
5. Determine maximum R-factor using specified return period

Enter option selection: 12 (options 1 and 2)

Enter start month-day as mmdd: 0401

Enter end month-day as mmdd: 0630

Enter R-factor filename* /cerlsys/etis/water/tips/datafiles/rfact/fbenning

Ranked interval and maximum R-values:

Interval	Maximum	Return Period	Probability
112.38	44.45	2.00	0.50
112.42	44.75	2.04	0.49
113.18	45.53	2.07	0.48
115.55	45.53	2.11	0.47
119.25	46.28	2.15	0.47
122.08	46.28	2.19	0.46
125.01	26.43	2.23	0.45
125.30	51.64	2.27	0.44
126.07	52.08	2.32	0.43
126.28	53.61	2.37	0.42
127.38	53.72	2.42	0.41
128.17	54.04	2.47	0.41
129.91	55.83	2.52	0.40
130.12	57.49	2.58	0.39
130.27	58.94	2.64	0.38

*Contact USA-CERL for assistance in establishing this datafile.

Interval	Maximum	Return Period	Probability
138.13	59.09	2.70	0.37
143.31	61.32	2.76	0.36
146.14	61.32	2.83	0.35
150.98	62.80	2.90	0.34
152.58	62.83	2.97	0.34
152.83	62.94	3.05	0.33
154.71	63.24	3.14	0.32
154.96	64.79	3.22	0.31
158.81	65.11	3.31	0.30
160.99	68.96	3.41	0.29
166.17	70.15	3.52	0.28
171.15	74.11	3.63	0.28
175.34	80.21	3.74	0.27
186.91	83.36	3.87	0.26
191.28	86.49	4.00	0.25
192.53	88.45	4.14	0.24
194.37	89.02	4.30	0.23
202.38	89.11	4.46	0.22
204.12	93.96	4.64	0.22
211.87	94.29	4.83	0.21
211.95	97.50	5.04	0.20
216.33	107.70	5.27	0.19
216.52	112.04	5.52	0.18
217.19	112.93	5.80	0.17
230.95	114.33	6.11	0.16
238.84	114.33	6.44	0.16
251.54	130.47	6.82	0.15
256.07	132.10	7.25	0.14
259.72	136.47	7.73	0.13
272.27	138.74	8.29	0.12
275.73	139.66	8.92	0.11
284.64	142.96	9.67	0.10
291.80	144.51	10.55	0.09
309.69	146.42	11.60	0.09
312.72	154.86	12.89	0.08
314.44	158.88	14.50	0.07
315.02	173.91	16.57	0.06
330.39	180.36	19.33	0.05
333.02	207.96	23.20	0.04
352.75	224.65	29.00	0.03
353.84	226.45	38.67	0.03
367.16	244.97	58.00	0.02
375.33	262.27	116.00	0.01

Enter project life in years: 1

Enter permissible risk of design storm exceedance as percent: 10

Design return should be 10.00

Design interval R-factor is 291.8

*** SUMMARY ***

Value to be entered for the interval R-factor using specified risk of exceedance is 291.8

Do you want another run? no

Enter installation code (CR to see list): 29

Enter R: 291

Enter K: 24

Enter C factor (CR to see tables): .004

Enter P factor (CR to see tables): 1.0

Enter LS: 1.5

Ready to execute USLE with the following data:

```
R  =  291.0
K  =  0.240
LS =  1.500
C  =  0.004
P  =  1.000
```

Soil loss is 0.419 (wt/unit area)

Do you want another go at it? no

Which option? (CR to see list): 9

Ending Land Evaluation.

Which topic? (CR to see list): 9

Goodby from TIPS.

4 DATA INPUT: MULTSED

MULTSED routes stormwater and sediment runoff from watersheds of complex geometry. Watersheds are segmented into subwatersheds, planes, and channels. Figure 1 shows how the watersheds of the Fort Riley Multi-Purpose Range Complex were segmented. Watershed geometry is then simplified into a representation suitable for computer simulation as shown in Figure 2.

MULTSED has three programs: MSED1, MSED2, and MSED3. MSED1 computes runoff and sediment from planes and subwatersheds. MSED2 sorts the hydrographs calculated by MSED1 into an order and common time grid suitable for numerical routing in the channel routing program (MSED3).

Users must provide input data for MSED1 and MSED3. MSED2 uses internally generated datafiles. If the user is interested in a single subwatershed or a single plane, then only the program MSED1 is required for the simulation. All three programs are required for complex watershed simulations. Figure 3 shows the computational scheme and datafiles required for simulations using all three programs. Datafiles are labeled as tape1, tape2, etc. The user need only be concerned with the input files for MSED1 (tape1 and tape2) and those for MSED3 (tape9 and tape10). Tape12 would be required if previously determined hydrographs are to be used as input to MSED3.

Appendix A describes the content and format of the five input datafiles: tape1, tape2, tape9, tape10, and tape12. An Rbase data management program has been developed for personal computer users. This program allows for interactive datafile construction, so the user need not be concerned with formatting. Terminal users must login to ETIS and create the datafiles using a text editor. To facilitate this process, input forms have been developed which describe the content and format of tapes 1, 2, 9, and 10 (Figures 4 through 7). Appendix B provides an example of datafiles which were used in the simulations of the Fort Riley MPRC.

MULTSED Applications

Because of the extensive data requirements for MULTSED, users are advised to develop datafiles for complex watersheds locally using a personal computer. Login time and disk storage would become excessive if many users tried to develop all their datafiles while logged into ETIS on the host computer. Therefore, it is preferable to build databases for MULTSED locally, although terminal users will have to perform this task while logged into ETIS.

The task of land evaluation will enable users to determine water and sediment yield for land areas of interest. Personal computer users will be able to select subwatersheds, planes, and channels to construct watersheds of interest. Rbase is designed to maintain, at the unit level, data which can be aggregated to construct a watershed for simulation. Terminal users will have to develop a set of datafiles for each area of interest. The results of land evaluation simulations will provide information on the current state of training lands.

The personal computer user will retrieve MULTSED output for use locally for the task of strategic analysis. Output will be maintained in the evaluation database for subsequent retrieval and analysis. Terminal users will maintain MULTSED output in their home directory on the host computer.

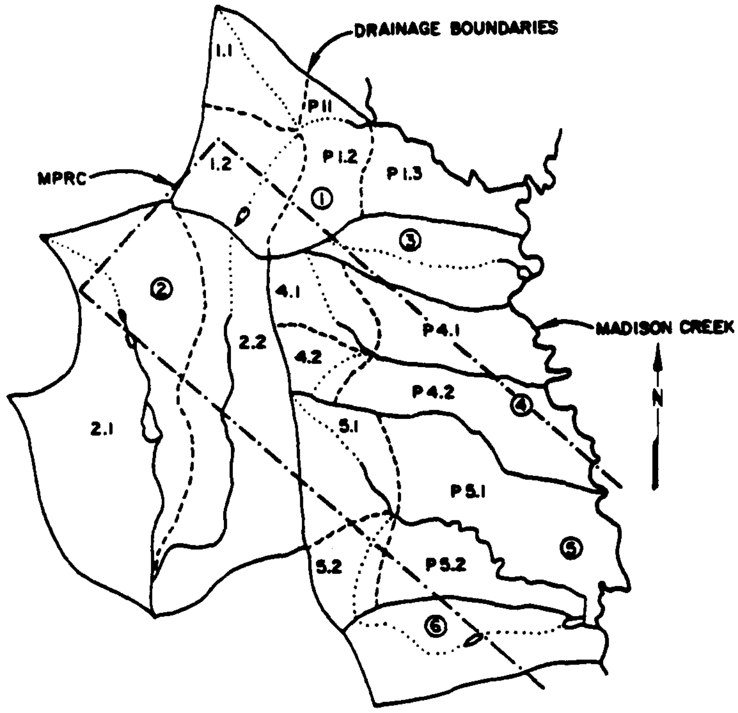

Figure 1. Drainage units and MPRC (Fort Riley).

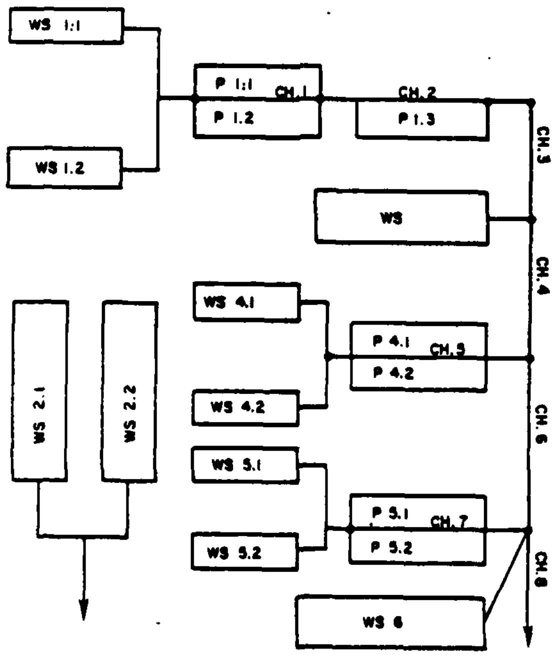

Figure 2. Schematic of drainage units.

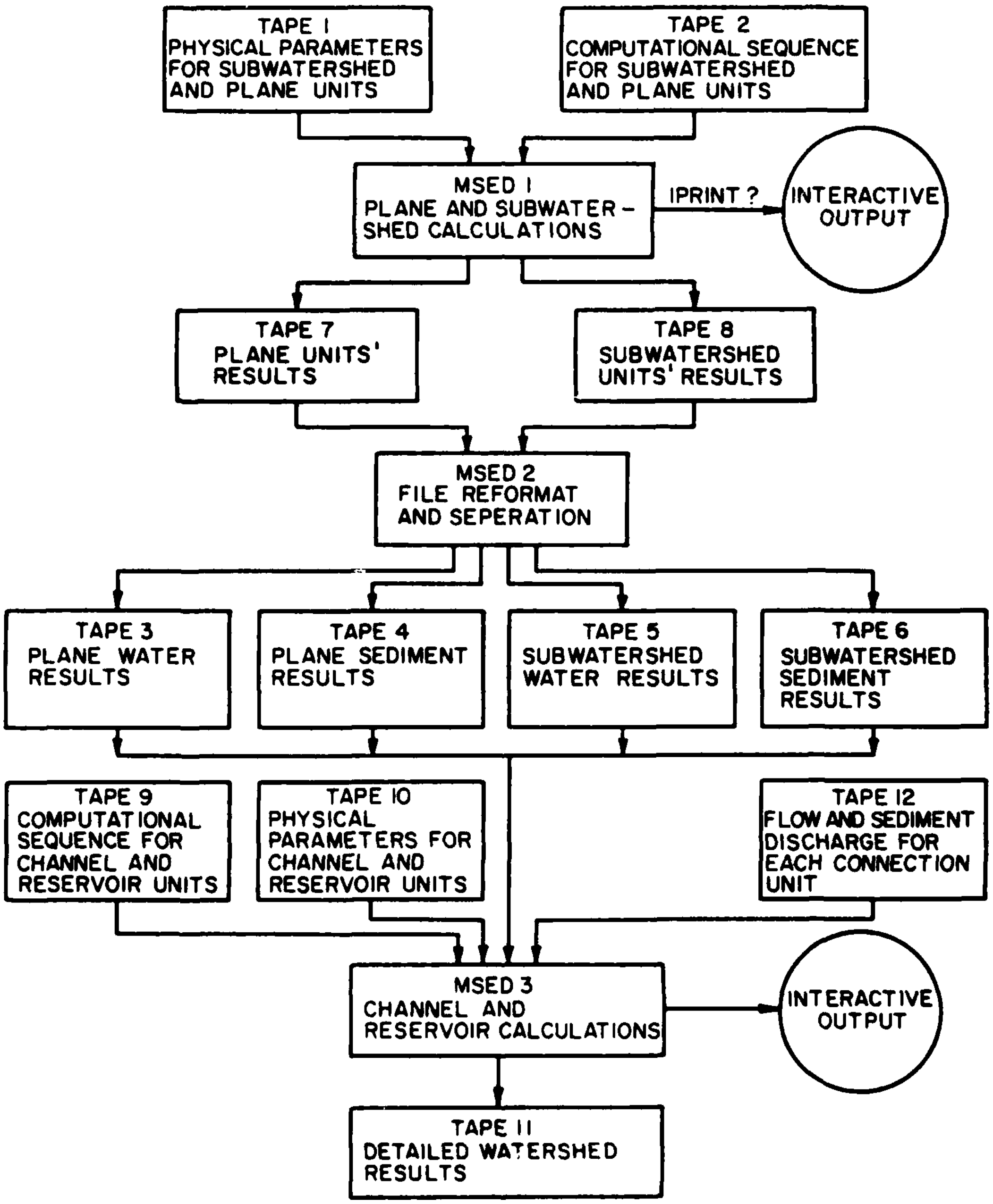

Figure 3. MULTSED structure.

Training Impact Prediction System

TAPE 1

PHYSICAL PARAMETERS FOR SUBWATERSHED & PLANE UNITS

LINE NUMBER								
1								
2	TITLE OF UNIT							
3	UNIT ID		IPLANE					
4 LEFT	WETK(1)	POROS(1)	SI(1)	SW(1)	SAVE(1)	PIASI(1)	COHM(1)	
5 RIGHT	WETK(2)	POROS(2)	SI(2)	SW(2)	SAVE(2)	PIASI(2)	COHM(2)	
	LINE 5-SUBWATERSHED ONLY							
6 LEFT	CON COV(1)	VC(1)	GRNCOV(1)	VG(1)	PIMP(1)			
7 RIGHT	CON COV(2)	VC(2)	GRNCOV(2)	VG(2)	PIMP(2)			
	LINE 7-SUBWATERSHED ONLY							
8 LEFT	SLOPE(1)	PLENGTH(1)	DPRES(1)					
9 RIGHT	SLOPE(2)	PLENGTH(2)	DPRES(2)					
	LINE 9-SUBWATERSHED ONLY							
10	SLOPE(3)	PLENGTH(3)						
11	N RAIN	T	XN	C	AI	BI	ADW	COHM(3)

12	RAINHOLD(I)	RAINT(I)	RAINHOLD(I)	RAINT(I)
	1	1	8	8
	2	2	9	9
	3	3	10	10
	4	4	11	11
	5	5	12	12
	6	6	13	13
	7	7 (CONTINUED)	14	14
			15	15

13	DCOEFF	DPOW	DOF	CHDOF	TAOCK	PLASI(3)	NSED

14	D(I)	P(I)	D(I)	P(I)
	1	1	6	6
	2	2	7	7
	3	3	8	8
	4	4	9	9
	5	5 (CONTINUED)	10	10

Figure 4. Format for tape1.

Training Impact Prediction System

TAPE 2

COMPUTATIONAL SEQUENCE, SUBWATERSHED & PLANE UNITS

LINE NUMBER

1 ______________________________ TITLE

2 __________ DTIM __________ FTIM

3 __________ NPL __________ NWS

LINE	ISEG(I)		ITYPE(I)		IPRINT(I)
4	1	1		1	
	2	2		2	
	3	3		3	
	4	4		4	
	5	5		5	
	6	6		6	
	7	7		7	
	8	8		8	
	9	9		9	
	10	10		10	

Figure 5. Format for tape2.

Training Impact Prediction System

TAPE 9

COMPUTATIONAL SEQUENCE, CHANNEL & RESERVOIR UNITS

LINE NUMBER

1 ______________________________ TITLE

2 __________ DTIM __________ FTIM

3 __________ NPL __________ NWS __________ NCON __________ NRES __________ NCH __________ NSED

LINE	ISEG(I)	IWS(I,1)	IWS(I,2)	IWS(I,3)	IPL(I,1)	IPL(I,2)	ICON(I)	IUP(I,1)	IUP(I,2)	IUP(I,3)
4	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9	9	9
	10	10	10	10	10	10	10	10	10	10

Figure 6. Format for tape9.

Training Impact Prediction System

TAPE 10

PHYSICAL PARAMETERS FOR CHANNEL & RESERVOIR UNITS

LINE NUMBER

1

2 TITLE

3 I TYPE(I)

THE FOLLOWING LINES 4 THRU 7 ARE FOR CHANNELS ONLY

4 SLEN(I) SLOPI(I) WETK(I) POROS(I) SI(I) SW(I) SUC(I) PIASI(F)

5 XN(I) C(I) T(I) COHM(I)

6 AI(I) BI(I) A2(I) B2(I) AGB(I) BEX(I) ADF(I) DELTS(I)

7

	D(I,J)		PF(I,J)
1	----------	1	----------
2	----------	2	----------
3	----------	3	----------
4	----------	4	----------
5	----------	5	----------
6	----------	6	----------
7	----------	7	----------
8	----------	8	----------
9	----------	9	----------
10	----------	10	----------

THE FOLLOWING LINES 4 AND 5 ARE FOR RESERVOIRS ONLY

4 VCAP(I) VITL(I) SAREA(I) POROS(I)

5

	D(I,J)
1	----------
2	----------
3	----------
4	----------
5	----------
6	----------
7	----------
8	----------
9	----------
10	----------

Figure 7. Format for tape10.

The task of predictive analysis will require the user to access the input datafiles and to change selected parameters to reflect what might occur as a result of training or land maintenance activity. Parameters describing soil or vegetation characteristics are most likely to be changed. Personal computer users can edit their datafiles locally and send the modified datafiles to the host computer. In this way, the prediction datafiles can be maintained locally. MULTSED has text-editing programs which can be used to make datafile modifications within ETIS. Terminal users should use this approach. Personal computer users can also use this approach. The MULTSED menu lists the option of datafile edit. The edit program listed will allow for modifications to the datafiles (tape1 and tape2) required for MSED1. The edit routines for tape9 and tape10 are contained within the MSED3 program and are listed as an option when MSED3 is being executed. These edit routines are interactive and self-explanatory.

A word of caution about input and output files maintained in the home directory: MULTSED always writes to the same filenames. For example, if the output file tape15 exists as a result of previous simulations, then if the user runs MSED1 again, tape15 will be overwritten with new output. Input files suffer the same fate. If the user edits an input file, then that file will be overwritten and original data can be lost. To avoid problems, the user should consider all "tape" files as temporary files used by MULTSED to perform simulations and record output. The user should consider creating permanent files using other filenames and copying files back and forth as simulations are performed.

Building Databases

Databases for MULTSED may be created and maintained either by using a terminal directly or by using a personal computer. The first approach requires that the user know the basics of the Unix editors "vi" and "ex". The database is then constructed using the format guidelines shown in Figures 4 through 7. There are four different guidelines, one for each of the files tape1, tape2, tape9, and tape10. Tape1 contains all the necessary information for planes and subwatersheds. Tape2 contains computational sequence data for planes and subwatersheds. Tape9 contains data for channels and reservoirs, and tape10 contains the corresponding computational sequence data.

Once these files are built, the user may then modify them as desired by using a built-in editor provided in the model. However, the original datafiles should first be saved under different filenames. Analysis options are then selected from the menu, and new output is generated.

Output for planes and subwatersheds is automatically stored in the file tape15, while output for channels and reservoirs is stored in file tape11. Final output for the entire watershed is stored in file tape16. The user may then save this information under files with different names for future reference.

The second approach to building databases does not require manual use of Unix editors. Instead, the user employs a database management package (Rbase) which allows the user to create and manipulate data files by using simple commands and responding to prompts. There is no formatting prerequisite as in the first approach. The Rbase commands needed to build databases are outlined and described below. Included with these commands are step-by-step procedures for uploading input files from the personal computer to the mainframe and downloading output from the mainframe to the personal computer.

Training Impact Prediction System

TAPE 10

PHYSICAL PARAMETERS FOR CHANNEL & RESERVOIR UNITS

LINE NUMBER

1

2 TITLE

3 I TYPE(I)

THE FOLLOWING LINES 4 THRU 7 ARE FOR CHANNELS ONLY

LINE								
4	SLEN(I)	SLOP1(I)	WETK(I)	POROS(I)	SI(I)	SW(I)	SUC(I)	PIASI(P)
5	XN(I)	C(I)	T(I)	COHM(I)				
6	A1(I)	B1(I)	A2(I)	B2(I)	AGB(I)	BEX(I)	ADF(I)	DELTS(I)

LINE		D(I,J)		PF(I,J)
7	1	----------	1	----------
	2	----------	2	----------
	3	----------	3	----------
	4	----------	4	----------
	5	----------	5	----------
	6	----------	6	----------
	7	----------	7	----------
	8	----------	8	----------
	9	----------	9	----------
	10	----------	10	----------

THE FOLLOWING LINES 4 AND 5 ARE FOR RESERVOIRS ONLY

LINE				
4	VCAP(I)	VITL(I)	SAREA(I)	POROS(I)

LINE		D(I,J)
5	1	----------
	2	----------
	3	----------
	4	----------
	5	----------
	6	----------
	7	----------
	8	----------
	9	----------
	10	----------

Figure 7. Format for tape10.

The task of predictive analysis will require the user to access the input datafiles and to change selected parameters to reflect what might occur as a result of training or land maintenance activity. Parameters describing soil or vegetation characteristics are most likely to be changed. Personal computer users can edit their datafiles locally and send the modified datafiles to the host computer. In this way, the prediction datafiles can be maintained locally. MULTSED has text-editing programs which can be used to make datafile modifications within ETIS. Terminal users should use this approach. Personal computer users can also use this approach. The MULTSED menu lists the option of datafile edit. The edit program listed will allow for modifications to the datafiles (tape1 and tape2) required for MSED1. The edit routines for tape9 and tape10 are contained within the MSED3 program and are listed as an option when MSED3 is being executed. These edit routines are interactive and self-explanatory.

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Building Databases

Databases for MULTSED may be created and maintained either by using a terminal directly or by using a personal computer. The first approach requires that the user know the basics of the Unix editors "vi" and "ex". The database is then constructed using the format guidelines shown in Figures 4 through 7. There are four different guidelines, one for each of the files tape1, tape2, tape9, and tape10. Tape1 contains all the necessary information for planes and subwatersheds. Tape2 contains computational sequence data for planes and subwatersheds. Tape9 contains data for channels and reservoirs, and tape10 contains the corresponding computational sequence data.

Once these files are built, the user may then modify them as desired by using a built-in editor provided in the model. However, the original datafiles should first be saved under different filenames. Analysis options are then selected from the menu, and new output is generated.

Output for planes and subwatersheds is automatically stored in the file tape15, while output for channels and reservoirs is stored in file tape11. Final output for the entire watershed is stored in file tape16. The user may then save this information under files with different names for future reference.

The second approach to building databases does not require manual use of Unix editors. Instead, the user employs a database management package (Rbase) which allows the user to create and manipulate data files by using simple commands and responding to prompts. There is no formatting prerequisite as in the first approach. The Rbase commands needed to build databases are outlined and described below. Included with these commands are step-by step procedures for uploading input files from the personal computer to the mainframe and downloading output from the mainframe to the personal computer.

PC Database Management System: Rbase and Extended Report Writer (XRW)

To access RBASE from Disk Operating System (DOS):

Type RBASE (CR)

There are two databases: WSP and WCR. WSP contains four relations: subwat, plane, par, and ssp. These hold data for subwatersheds, planes, parcels, and the computational sequence for planes and subwatersheds, respectively. WCR contains three relations: chan, res, and scr. These hold data for channels, reservoirs, and the computational sequence for channels and reservoirs, respectively. To open the database WSP:

Type OPEN WSP (CR)

Rbase responds by telling the user that this database exists. To see what relations are in WSP:

Type LISTREL (CR)

Rbase responds by listing its four relations. To see what attributes (variables) exist in any particular relation (e.g., plane):

Type LISTREL PLANE (CR)

Rbase responds by listing all the attributes in the relation "plane". To display attributes and their values in any relation (e.g., plane):

Type SELECT (list attributes or ALL) FROM PLANE (CR)

Rbase responds by listing the specified attributes along with their corresponding values for each row of data in "plane". To add new rows of data to a particular relation (e.g., plane):

Type LOAD PLANE WITH PROMPTS (CR)

Rbase will prompt the user to enter a value for each attribute in the relation "plane". (See Appendix A in order to identify the names of the variables correctly.)

From time to time, the user may want to change some of the data in a particular relation. This may be done with the EDIT command:

Type EDIT (list of attributes or ALL) FROM PLANE (CR)

Rbase will prompt the user to make changes for each row in the relation "plane". Another useful command is PROJECT. This command allows the user to reduce the size of a particular relation when only a subset of data is needed. A new relation is formed that has fewer rows/columns than the old one. The syntax for this command is:

PROJECT newname FROM oldname USING (LIST of attributes or ALL) + WHERE (attribute specifications)

Rbase has other commands, and there are many other ways to use the commands listed above. (See the Rbase user reference manual.[7]) The example session given in Appendix C also gives more details about using the Rbase commands.

Once all the data has been entered and/or modified, it must be arranged in a format suitable for input to MULTSED. This is done by selecting one of six programs for reporting formatted data. To report formatted data from a particular relation:

Type EXIT (CR) (returns to DOS)
Type XRW (CR)

The user is now in the extended report writer mode XWR:

Type R
Type SUBWAT, PLANE, CHAN, RES, SSP, or SCR (CR)

These programs will report formatted data from the relations subwat, plane, chan, res, ssp, or scr, respectively.

Type tape1, tape2, tape9, or tape10 (CR)

Tape1 is used for subwat or plane, tape2 for ssp, tape9 for scr, and tape10 for chan or res. These files reside on the personal computer hard disk (with a "1st" suffix attached).

When the report is finished:

Type Q (returns to DOS)
Type ST100 (CR)
Type 1

The last two commands give access to the mainframe, and the user should be in his/her home directory. The following section shows how files are uploaded (transmitted) to the mainframe from the personal computer.

Uploading

To transmit tape1.1st to the mainframe:

Type shift-F3 (create new tape1 in mainframe home directory)
or shift-F7 (add to existing tape1 in mainframe home directory)
Type TAPE1.LST (CR)

To transmit tape2.1st to the mainframe:

Type shift-F4 (create new tape2 in mainframe home directory)
or shift-F8 (add to existing tape2 in mainframe home directory)
Type TAPE2.LST (CR)

---

[7] *Relational Database Management User's Manual, Version 1.1* (Microrim, March 1984).

To transmit tape9.1st to the mainframe:

Type shift-F5 (create new tape9 in mainframe home directory)
or shift-F9 (add to existing tape9 in mainframe home directory)
Type TAPE9.LST (CR)

To transmit tape10.1st to the mainframe:

Type shift-F6 (create new tape10 in mainframe home directory)
or shift-F10 (add to existing tape10 in mainframe home directory)
Type TAPE10.LST (CR)

When transmission is complete:

Type alt-F8 (wait till cursor sits in upper left corner of screen)
Type control-D

The next section shows how to download MULTSED output files from the mainframe to the personal computer.

Downloading

To download model output to Rbase:

Type shift-F2 (capture output)
Type <name of output file> (CR)
Type Rbase (CR)
Type OPEN REPORT (CR)
Type LOAD <relation> FROM <name of receiving file>
Type END

5 SUMMARY

Army training lands can be improved physically when land managers are better able to identify maintenance needs based on land evaluation and predicted degradation. This report describes the use and implementation of the Training Impact Prediction System (TIPS), a computer-based system that Army land managers can use to accomplish this task. TIPS is described in terms of system structure, potential uses of the system, the prediction techniques contained in the system and database management procedures. Prediction techniques include the Universal Soil Loss Equation (USLE), the Interval USLE, and MULTSED for a comprehensive analysis of watershed degradation and sedimentation. TIPS is accessed through the Environmental Technical Information System (ETIS), the umbrella system to which it will eventually be added. When complete, TIPS will provide a user-friendly series of computer programs for use at all Army installations. As this research progresses, similar systems will be developed for predicting chemical and biological degradation at Army training grounds.

APPENDIX A:

FORMAT AND CONTENTS OF TAPES 1, 2, 9, 10, AND 12

Table A1

Format and Contents of Tape1
Physical Parameters for Subwatershed and Plane Units

Line Number	Columns	Format	Variable Label	Contents
1	1-80	--	--	Blank
2	1-80	A10	--	Title of unit and any other information
3	1-12	3A4	None	Unit identification
	13-22	I10	IPLANE	1 = plane unit 2 = subwatershed unit
4 (left plane (soil properties)	1-10	F10.0	WETK(1)	Hydraulic conductivity (in./hr)
	11-20	F10.0	POROS(1)	Porosity
	21-30	F10.0	SI(1)	Initial soil moisture (fraction)
	31-30	F10.0	SW(1)	Final soil moisture (fraction)
	41-50	F10.0	SAVE(1)	Average capillary suction (in.)
	51-60	F10.0	PLASI(1)	Plasticity index, (percent)
	61-70	F10.0	COHM(1)	Erosion rate constant for cohesive soils (lb/sq ft-sec)
5 (right plane soil properties)		(Same variables as line 4 except for the right side of the subwatershed. If a plane unit is being considered, this line is blank. The array indices are all 2.)		

Table A1 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
6 (left plane vegetative and cover characteristics)	1-10	F10.0	CANCOV(1)	Percent of area with canopy cover
	11-20	F10.0	VC(1)	Potential storage volume per area for canopy cover (in.)
	21-30	F10.0	GRNCOV(1)	Percent of area with ground cover
	31-40	F10.0	VG(1)	Potential ground cover storage volume per area (in.)
	41-50	F10.0	PIMP(1)	Percent of area which has impervious cover
7 (right plane vegetative and cover characteristics)		(Same as line 6 except for the right side of the subwatershed. This line is blank if a plane is being considered. The array indices are all 2.)		
8	1-10	F10.0	SLOPE(1)	Overland slope of the left side of a subwatershed or a single plane unit
	11-20	F10.0	PLENGTH(1)	Length of overland slope for left plane (ft)
	21-30	F10.0	DPRES(1)	Fraction of left plane which does not contribute to flow because of depressions.
9 (This line is blank for a single plane unit)	1-10	F10.0	SLOPE(2)	Overland slope of the right plane

Table A1 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
	11-20	F10.0	PLENGTH(2)	Length of overland slope for the right plane (ft)
	21-30	F10.0	DPRES(2)	Fraction of right plane which does not contribute to flow because of depression.
10	1-10	F10.0	SLOPE(3)	Channel slope
	11-20	F10.0	PLENGTH(3)	Channel length (ft) (Note: This is the neighboring channel unit in the case of a plane.)
11	1-10	I10	NRAIN	Number of rainfall increments
	11-20	F10.0	T	Soil temperature (^{o}F)
	21-30	F10.0	XN	Manning's n for channel (blank if Chezy C is used)
	31-40	F10.0	C	Chezy C for channel (blank if Manning's n is used)
	41-50	F10.0	A1	A1 in P = A1*A**B1 (Note: if A1 is 0.0, the triangular approximation is used)
	51-60	F10.0	B1	B1 in above
	61-70	F10.0	ADW	Maximum resistance parameter for overland flow
	71-80	F10.0	COHM(3)	Erosion rate constant for cohesive soil in subwatershed channels (lb/sq ft-sec)

Table A1 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
12 (rainfall hyetograph)	1-10	F10.0	RAINOLD(I)	Rainfall intensity (in./hr)
	11-20	F10.0	FAINT(I)	Ending time of rainfall intensity (min)
		(This line must be repeated NRAIN times)		
13 (sediment properties)	1-10	F10.0	DCOEFF coefficient	Rainfall splash detachment
	11-20	F10.0	DPOW	Rainfall splash exponent (usually 2)
	21-30	F10.0	DOF	Overland flow detachment coefficient
	31-40	F10.0	CHDOF	Channel detachment coefficient (blank if single plane unit)
	41-50	F10.0	TAOCK	Shields' critical shear parameter
	51-60	F10.0	PLASI(3)	Plasticity index for soil in subwatershed channel (percent)
	61-70	I10	NSED	Number of sediment sizes (this number must be identical for all units)
14 (Sediment grain size distribution from smallest to largest	1-10	F10.0	D(I) (mm)	Sediment diameter
	11-20	F10.0	P(I)	Fraction of sediment equal to or finer than this size

This line is repeated NSED times

The same order of inputs is followed for the next plane or subwatershed.

Table A2

Format and Contents of Tape2
Computational Sequence, Plane and Subws Units

Line Number	Columns	Format	Variable Label	Contents
1	1-10	BA10	TITLE	Title of simulation
2	1-80	F10.0	DTIM	Time increment (min)
		F10.0	FTIM	Total length of simulation (min)
3	1-10	I10	NPL	Number of planes in the watershed
	11-20	I10	NWS	Number of sub-watershed units in the watershed
4 (Line 4 is repeated for NPL+NWS units)	1-10	I10	ISEG(I)	Segment number for the I^{th} unit (ISEG(I) must equal I)
	11-20	I10	ITYPE(I)	1 = plane unit 2 = subwatershed unit
	21-30	I10	IPRINT(I)	If results are to be printed, IPRINT(I) must be positive; if negative, results are not printed.

Table A3

Format and Contents of Tape9
Channel Computational Sequence

Line Number	Columns	Format	Variable Label	Contents
1	1-80	8A10	TITLE	Title of simulation
2 (DTIM and (FTIM must (agree with tape2 values)	1-10	F10.0	DTIM	Time increment (min)
	11-20	F10.0	FTIM simulation	Total length of (min)
3	1-10	I10	NPL	Number of planes (must agree with tape2)
	11-20	I10	NWS	Number of sub-watersheds (must agree with tape2)
	21-20	I10	NCON	Number of connection units
	31-40	I10	NRES	Number of reservoir units
	41-50	I10	NCH	Number of channel units
	51-60	I10	NSED	Number of sediment sizes (must agree with tape1)
4 (Computational sequences)	1-5	I5	ISEG(I)	Channel or reservoir identification number (ISEG(I) must equal I)
	6-20	3I5	IWS(I,J)	Identification number of all subwatershed units that flow into ISEG(I) (up to a maximum of three)

Table A3 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
	21-30	2I5	IPL(I,J)	Identification number of plane units which flow into ISEG(I). (For the case when ISEG(I) is a reservoir, no plane units are allowed.)
	31-35	I5	ICON(I)	Identification of inflowing connection unit
	36-50	3I5	IUP9I(J)	Identification number of upstream input units which are either channels or reservoirs (these numbers correspond to the ISEG number assigned earlier to the inflowing unit)

This line is repeated for each of the channel and reservoir units (a total of NCH + NRES).

Table A4

Format and Contents of Tape10
Channel Physical Parameters (Includes Reservoirs)

Line Number	Columns	Format	Variable Label	Contents
1	1-80	-	-	Blank
2	1-80	-	-	Channel or reservoir name and other information (this line is not read)
3	1-10	I10	ITYPE(I)	1 = channel unit 2 = reservoir unit
4 (for the case of a channel)	1-10	F10.0	SLEN(I)	Slope length of channel (ft)
	11-20	F10.0	SLOP(I)	Slope of channel
	21-30	F10.0	WETK(I)	Hydraulic conductivity in channel (in./hr)
	31-40	F10.0	POROS(I)	Porosity of channel bed
	41-50	F10.0	SI(I)	Initial saturation of channel (fraction)
	51-60	F10.0	SW(I)	Final saturation of channel (fraction)
	61-70	F10.0	SUC(I)	Capillary suction of channel bed (in.)
	71-80	F10.0	PLASI(F)	Plasticity index of channel bed material (percent)
5 (for the case of a channel)	1-10	F10.0	XN(I)	Manning's n (blank if Chezy C is used)
	11-20	F10.0	C(I)	Chezy C (blank if Manning's n is used)
	21-30	F10.0	T(I)	Temperature of channel soil (^{o}F)

Table A4 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
	31-40	F10.0	COHM(I)	Erosion rate constant for cohesive soils in channel bed (lb/sq ft-sec)
6 (for the case of a channel)	1-10	F10.0	A1(I)	A1 in P = A1*A**B1
	11-20	F10.0	B1(I)	B1 in above
	21-30	F10.0	A2(I)	A2 in T = A2*A**B2
	31-40	F10.0	B2(I)	B2 in above
	41-50	F10.0	AGB(I)	Coefficient for bed load transport equation (0.056 if MPM is used)
	51-60	F10.0	BEX(I)	Exponent for bed load transport equation (1.5 if MPM is used)
	61-70	F10.0	ADF(I)	Detachment coefficient for channel bed
	71-80	F10.0	DELTS(I)	Shields' critical shear parameter
7 (for the case of a channel)	1-10	F10.0	D(I,J)	Sediment size (mm) must agree with sizes from tape1 (listed from smallest to largest)
	11-20	F10.0	PF(I,J)	Fraction of sediment equal to or smaller than given diameter
	This line is repeated NSED times			
4 (for the case of a reservoir)	1-10	F10.0	VCAP(I)	Storage capacity of reservoir (acre-ft)
	11-20	F10.0	FITL(I)	Initial volume stored in reservoir at start of storm (acre-ft)

Table A4 (Cont'd)

Line Number	Columns	Format	Variable Label	Contents
	21-30	F10.0	SAREA(1)	Surface area of reservoir (acre)
	31-40	F10.0	POROS(1)	Porosity of deposited material
5 (for the case of a reservoir)	1-10	F10.0	D(I,J)	Sediment size (mm) Must agree with size from tape1

This line is repeated NSED times

Note: For the case of a channel, lines 4 through 7 are used, but for the case of a reservoir, only 4 through 5. Lines 1 through 3 are used in both cases and have identical meanings.

Table A5

Format and Contents of Tape12
Reservoir Connection Information

Line Number	Columns	Format	Variable Label	Contents
1	1-80	-	-	
2	1-10	F10.0	QCON(JJ)	Discharge from the JJth connection for the given time interval (cfs)
3	1-80	F10.0	GBOCON (JJ,M)	Sediment discharge from the connection unit at the given time for each size fraction (cfs) (there should be NSED-1 inputs)

Lines 1 through 3 are repeated for each connection unit for the given time interval. The sequence is then repeated again for the next time interval. The file must use the same intervals as the output hydrograph.

APPENDIX B:

EXAMPLE DATAFILES FOR THE FORT RILEY MPRC

Tape1

```
Fort Riley MPRC Erosion Model
WS-1 2                      2
  0.300000    0.490000    0.500000   01.00000   08.60000   00010.010    0.000120
  0.300000    0.490000    0.500000   01.00000   08.60000   00010.010    0.000120
  0.000000    0.000000   80.000000   0.050000   0.000000    0.000000
  0.000000    0.000000   80.000000   0.050000   0.000000    0.000000
  0.039000     1035.00    0.000000
  0.041000      443.00    0.000000
  0.018000      1912.0
         4      75.000       0.060      0.000      0.000       0.000  100000.000   0.00012

5.76       15.00
2.76       30.00
2.04       45.00
1.44       60.00
  0.001000  2.000000     9.856700   1.000000   0.047000   00010.010                10
0.0002     0.00000000
0.0200     0.10000000
0.0500     0.15000000
0.075      0.18000000
0.125      0.25000000
0.250      0.41000000
0.500      0.64000000
2.000      0.85000000
4.750      0.88000000
12.70      1.00000000
```

Tape2

```
Fort Riley MPRC Erosion Study

          5.0              150.0
          7                   10
          1                    2                    01
          2                    2                    01
          3                    1                    01
          4                    1                    01
          5                    1                    01
          6                    2                    01
          7                    2                    01
          8                    2                    01
          9                    2                    01
          10                   2                    01
          11                   1                    01
          12                   1                    01
          13                   2                    01
          14                   2                    01
          15                   1                    01
          16                   1                    01
          17                   2                    01
```

Tape9

Fort Riley MPRC Erosion Study

	5.0		150							
	7		10		0		0		8	10
1	1	2	0	1	2	0	0	0	0	
2	0	0	0	3	0	0	1	0	0	
3	0	0	0	0	0	0	2	0	0	
4	5	0	0	0	0	0	3	0	0	
5	6	7	0	4	5	0	0	0	0	
6	0	0	0	0	0	0	5	0	0	
7	8	9	0	6	7	0	0	0	0	
8	10	0	0	0	0	0	6	7	0	

Tape10

Fort Riley CH-3

1

2160	0.005000	0.01	.49	0.99	1.0	0.001	12.00
.040		75.	.000102				
6.6100	0.3200	06.61000	.320000	.056	1.5	.00001	.047
0.0002	0.00000000						
0.020	0.10000000						
0.050	0.15000000						
0.075	0.18000000						
0.125	0.25000000						
0.250	0.41000000						
0.500	0.64000000						
2.000	0.85000000						
04.75	0.88000000						
12.70	1.00000000						

APPENDIX C:

EXAMPLE SESSION WITH RBASE

The OPEN command is used to open the database WSP:

```
OPEN WSP

  Database exists
```

LISTREL lists all existing relations in the database:

```
LISTREL

      Relations in the database WSP
      ssp        subwat        plane        par
```

The four relations in the database WSP contain data for planes, subwatersheds, and parcels. (Relations containing data for channels and reservoirs are in the database WCR). The command LISTREL followed by the name of a relation lists all existing attributes in that relation:

```
LISTREL PLANE

      Relation: plane
      Read Password: NO
      Modify Password: NO

       Attributes
       #  Name      Type       Length              Key
       1  title     TEXT       80 characters
       2  code      INTEGER    1 value(s)
       3  iplane    INTEGER    1 value(s)
       4  date      DATE       1 value(s)


       82 p 10      REAL       1 value(s)

       Current number of rows:     2
```

The SELECT command displays attributes and their corresponding values as shown below:

```
SELECT WETKE POROS1 SI1 GRNVOV1 VC1 VG1 FROM PLANE

wetk1      poros1     si1        sw1        grncov1     vc1        vg1

1.00000    0.58540    0.55260    0.90000    64.00000    0.00000    0.05000
1.00000    0.58570    0.55830    0.90000    65.00000    0.00000    0.05000
```

This LOAD command is used to add a new row of data to the relation "plane". Rbase prompts the user to enter a value for each attribute in plane. The last value is entered for attribute p10, and ESC is hit. This ends Rbase data loading.

```
LOAD PLANE WITH PROMPTS

 Begin R:base Data Loading

 Press [ESC] to end, [ENTER] to continue

  title    (TEXT     ):     Laguna
  code     (INTEGER):       3
  iplane   (INTEGER):       1
  date     (DATE     ):     11/07/84

  p10      (REAL     ):     1.0

          Press [ESC] to end, [ENTER] to continue

  End R:base Data Loading
```

The EDIT command is used to change a value in the second row of PLANE:

```
EDIT WETKI POROS1 SI1 SW1 GRNCOV1 VC1 VG 1 FROM PLANE
```

The following screen displays the first row of the relation "plane":

```
C(hange entry), R(eset), (Skip), E(dit), D(elete), Q(uit): s

wetk1     : 1.000000                 pos1        : 0.58540
si1       : 0.55260      sw1         : 0.90000
grncov1   : 64.0000      vc1         : 0.00000
vg1       : 0.05000
```

The first row is skipped, and the second row is displayed in the next screen:

```
C(hange entry), R(eset), S(kip), E(dit), D(elete), Q(uit): e

wetk1     : 1.000000                 pos1        : 0.58570
si1       : 0.55830      sw1         : 0.90000
grncov1   : 65.0000      vc1         : 0.00000
vg1       : 0.05000
```

The edit option is chosen, and vg1 is changed from 0.05 to 0.06 (see next screen). The cursor then returns to the options prompt, and the change option is selected.

C(hange entry), (R(eset), S(kip), D(elete), Q(uit): c

wetk1	: 1.000000			pos1	: 0.58570
si1	: 0.55830	sw1	: 0.90000		
grncov1	: 65.0000	vc1	: 0.00000		
vg1	: 0.06000				

The following screen displays an edit summary showing how many rows were changed or deleted:

---

1 row(s) were changed
0 row(s) were deleted

All the commands above can be used on the other relations, both in the database WSP and the database WCR. Only one database may be opened at a time. The EXIT command is used to end the Rbase session.

EXIT

End Rbase 4000 Version 1.01 MSDOS

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DLA ATTN: DLA-WI 22314

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ATTN: DEH (23)

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Fitzsimons AMC 80240
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MTMC
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